TECHNICAL MEMORANDUM

Utah Coal Regulatory Program

July 7, 2016

TO: The Utah Board of Oil, Gas, and Mining

THRU: Dana Dean, Associate Director
Daron Haddock, Program Manager

FROM: Amanda Daniels, Hydrologist

RE: Crandall Canyon Mine Discharge Water Board Update, Docket No. 2010-026, Cause No. C/015/0032

SUMMARY:

Attached please find the Division of Oil, Gas and Mining's six month update report on the total iron concentrations in the mine discharge water at the Crandall Canyon Mine. This report is submitted in compliance with the January 28, 2013 Board Order.

Crandall Canyon Mine Hydrologic Evaluation Update
July 8, 2016

Introduction

The Division of Oil, Gas and Mining (the Division) completed a Hydrologic Evaluation of the Crandall Canyon Mine Water Discharge in June 2010. Since that time, numerous reports have been prepared by the Division and Genwal Resources, Inc. (Genwal) that examine the mine discharge water at Crandall Canyon. In compliance with the January 28, 2013, Board of Oil, Gas and Mining (the Board) Order[1], the following report presents an update on the data collected through May 2016. The report will focus on data collected since approximately January 2010 (after total iron concentrations in the discharge peaked). The following sections of this updated report describe: the data currently being collected, plots which have been prepared to examine the data, and a recent data evaluation. Due to upcoming changes to the Genwal UPDES permit, and current data trends, a predictive compliance analysis was not conducted. This will be discussed further in the report.

Sampling

Genwal has continued to perform monthly sampling and analysis of the mine discharge water in accordance with the Crandall Canyon Mining and Reclamation Plan (MRP). In addition, Genwal has occasionally collected laboratory analysis samples more frequently than required by the MRP and has also been sampling the discharge using a total iron field analysis. The sampling is conducted to evaluate the need for continued treatment of the mine discharge water in order to meet the 1.24 mg/L maximum daily effluent limitation (MDEL) for total iron in accordance with their Utah Pollutant Discharge Elimination System (UPDES) permit. In addition, treatment is required for compliance with the narrative standard of Section I.C of the UPDES permit.

In October 2012, Genwal installed a new continuous flow sampling port and began collecting samples at this location. In March 2013, the continuous flow sampling port was destroyed by a rock fall from a high wall. After consultation with the Division, a new continuous flow sampling port was installed in March 2013. For purposes of this report, data from both continuous flow sampling ports will be viewed as equivalent. All samples taken since March 2013 were collected at the new continuous flow sampling port.

Current Data Graphs

Untreated total iron concentrations from January 2007 through May 2016 are plotted in Exhibit 1. The monthly median total iron concentrations from January 2010 to May 2016 are plotted in Exhibit 2. Exhibit 3 shows only the continuous flow sampling port, monthly median total iron concentrations, from October 2012 to May 2016. Average mine discharge flow rates are displayed in Exhibit 4. Total iron concentrations after treatment are shown in Exhibit 5. Mine discharge water chemistry analytical results from January 2007 to May 2016 and monthly medians for total iron are tabulated in Exhibit 6.

Recent Data

The total iron concentrations, collected from January to May of 2016, have fluctuated as low as 0.96 mg/L and as high as 1.6 mg/L, with a six month average concentration of 1.51 mg/L and a standard deviation of 0.22 mg/L. Comparing this information to the previous 6 months, the average total iron concentration has decreased. This is a good improvement in total iron concentrations compared to the previous year of data.

Compliant Discharge

Of the 10 mine discharge water samples collected from January thru May 2016, 8 samples reported total iron concentrations below the MDEL of 1.24 mg/L, as defined in Genwal's UPDES permit. This is an encouraging decrease in total iron concentration.

Currently, the UPDES permit is in the process of being renewed through the Utah Division of Water Quality (DWQ). During UPDES permit renewals, the MDEL of each effluent parameter as outlined in the discharge permit (Section I.D), are re-calculated by the DWQ. These MDEL re-calculations are conducted using a standardized method that evaluates the most recent data available for the effluent receiving stream. Through recent discussions between the Division and DWQ, they have indicated that the effluent limit of total iron at Genwal is likely to change. Due to these upcoming changes, it did not seem prudent to make any conclusions about the continued treatment of mine water until after the UPDES permit is renewed. The next hydrologic update will include an evaluation using this new MDEL of total iron, if the new limit is been finalized by DWQ at the time of the report.

Conclusion

With the currently available data, and potential changes to the MDEL of total iron, the Division feels that it is prudent to continue collecting data to support accurate evaluations of total iron trends. The decrease in total iron concentrations is encouraging and should continue to be closely watched. The Division recommends continuing to compile total iron concentration evaluations every six months based on newly available data. The continued treatment of mine water discharge is also highly dependent on the MDEL of total iron concentrations in the UPDES permit. Once the UPDES permit is renewed, and the new limits finalized, the Division will have a better understanding of what the future of mine water treatment could entail.

References

1. Board of Oil, Gas and Mining., Findings of Fact, Conclusions of Law and Order, Docket No. 2010-026, Cause No. C/0150032, January 28, 2013.
2. Petersen, E.C. 2011. Investigation of Iron Concentration in the Genwal Resources, Inc. Crandall Canyon Mine Discharge Water, November 7, 2011
3. Gilbert, R.O., 1987. Statistical methods for environmental pollution monitoring. Van Nostrand Reinhold, New York.
4. Perry and Rauch. Estimating Water Quality Trends in Abandoned Coal Mine-pools, Presented at West Virginia Mine Drainage Task Force Meeting (sourced online as a white paper), March 26-27, 2013, Morgantown, WV

Exhibit 1

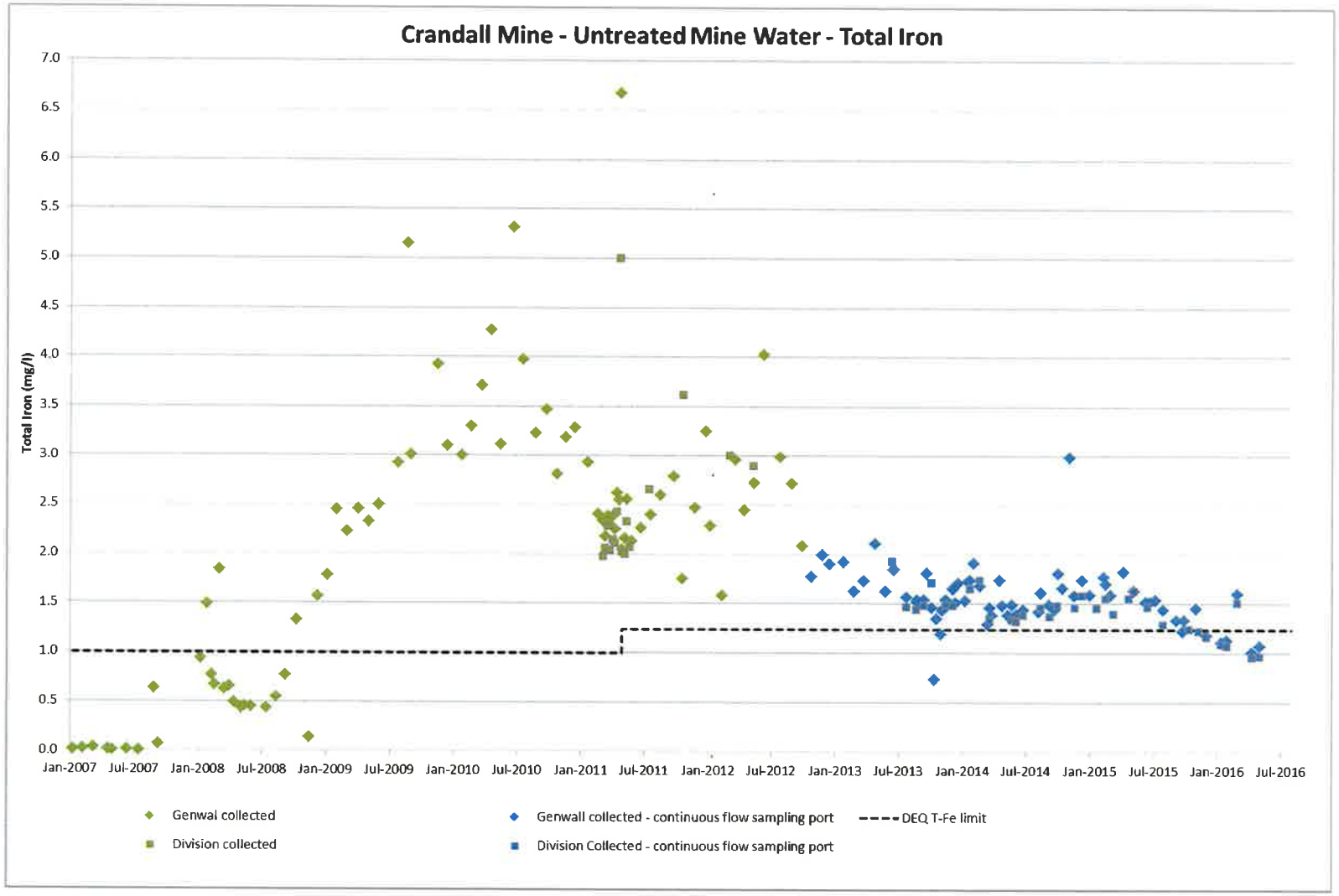
Crandall Mine - Untreated Mine Water - Total Iron
Total Iron (mg/l)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan-2007
Jul-2007
Jan-2008
Jul-2008
Jan-2009
Jul-2009
Jan-2010
Jul-2010
Jan-2011
Jul-2011
Jan-2012
Jul-2012
Jan-2013
Jul-2013
Jan-2014
Jul-2014
Jan-2015
Jul-2015
Jan-2016
Jul-2016
Genwal collected
Division collected
Genwall collected - continuous flow sampling port
Division Collected - continuous flow sampling port
DEQ T-Fe limit

Exhibit 2

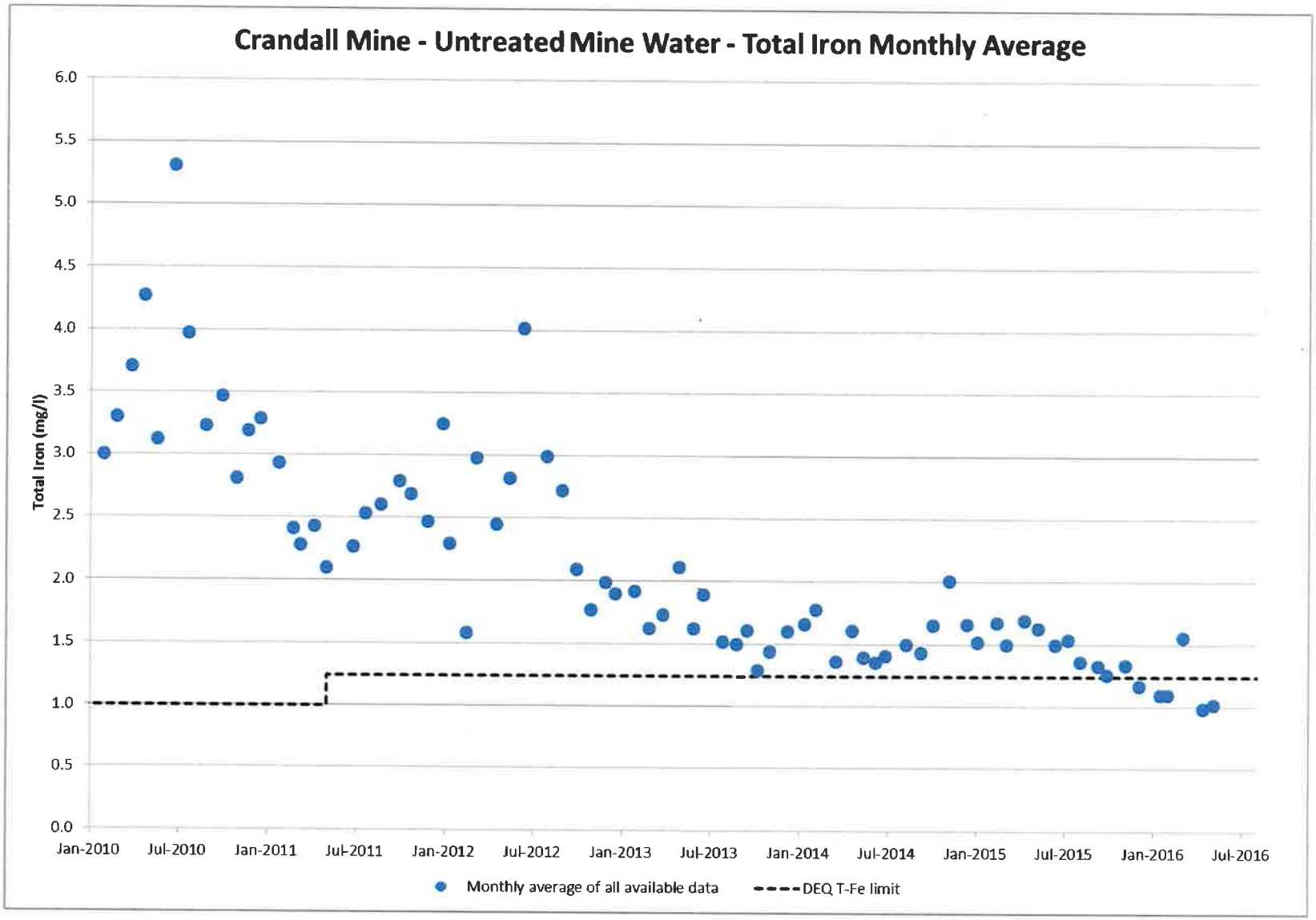
Crandall Mine - Untreated Mine Water - Total Iron Monthly Average
Total Iron (mg/l)
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan-2010
Jul-2010
Jan-2011
Jul-2011
Jan-2012
Jul-2012
Jan-2013
Jul-2013
Jan-2014
Jul-2014
Jan-2015
Jul-2015
Jan-2016
Jul-2016
Monthly average of all available data
DEQ T-Fe limit

Exhibit 3

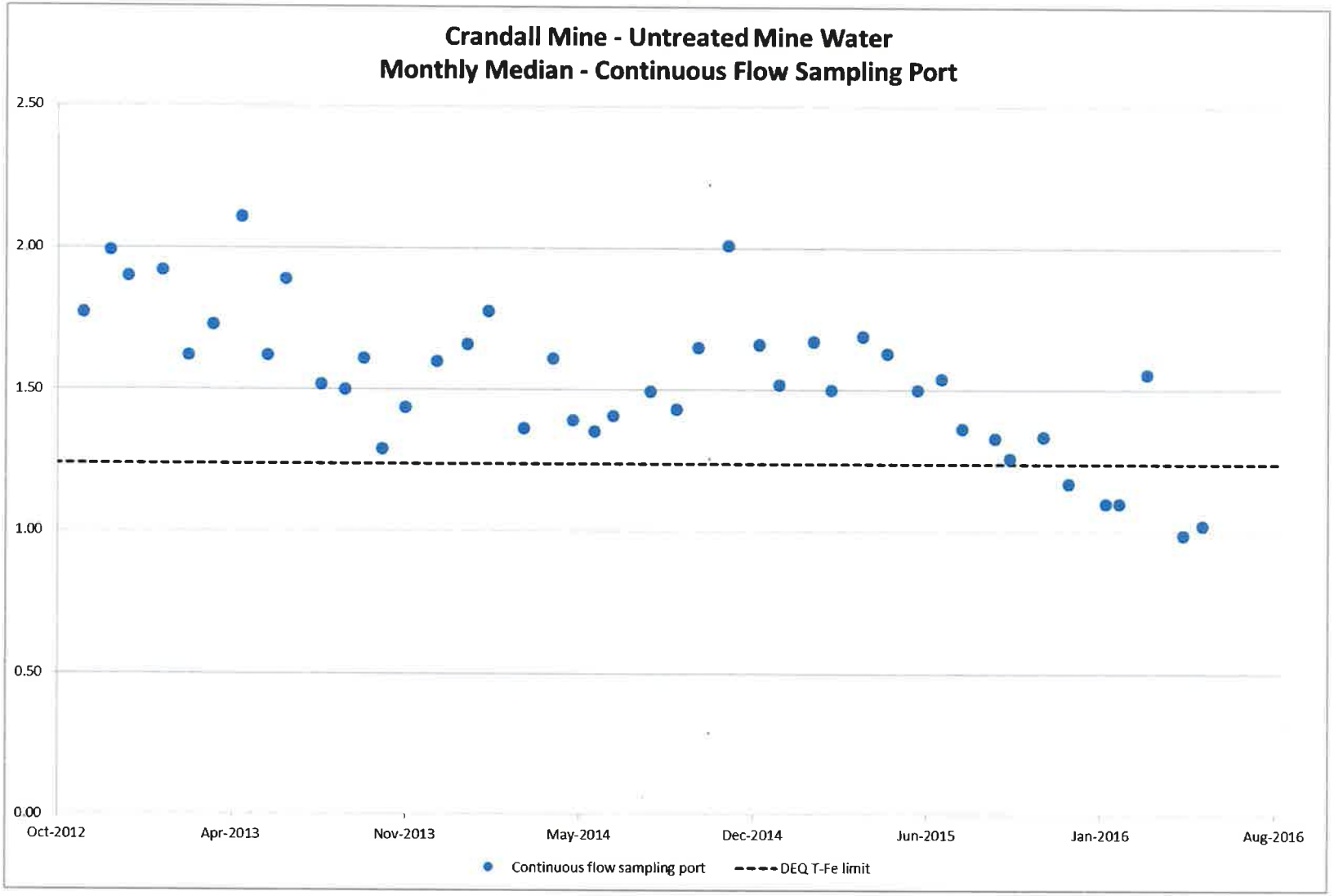
Crandall Mine - Untreated Mine Water
Monthly Median - Continuous Flow Sampling Port
2.50
2.00
1.50
1.00
0.50
0.00
Oct-2012
Apr-2013
Nov-2013
May-2014
Dec-2014
Jun-2015
Jan-2016
Aug-2016
Continuous flow sampling port
DEQ T-Fe limit

Exhibit 4

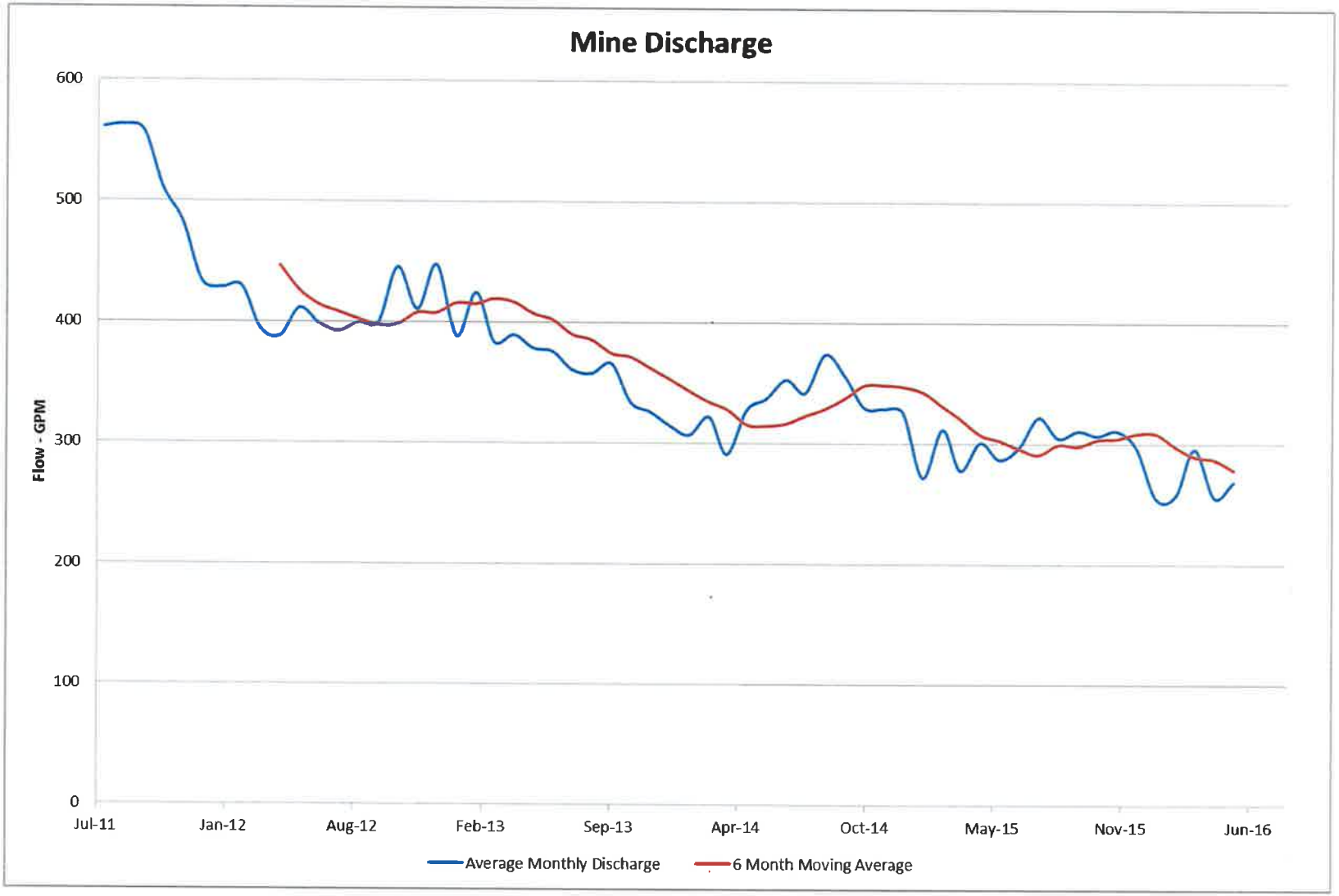
Mine Discharge
600
500
400
300
200
100
0
Flow - GPM
Jul-11
Jan-12
Aug-12
Feb-13
Sep-13
Apr-14
Oct-14
May-15
Nov-15
Jun-16
Average Monthly Discharge
6 Month Moving Average

Exhibit 5

Sample Date	Total iron (mg/L) pretreatment sampling results	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median
total iron (mg/L)				
1/8/2007	0.012		G	
2/6/2007	0.015		G	
3/7/2007	0.033		G	
4/18/2007	0.013		G	
5/1/2007	< .005		G	
6/13/2007	0.012		G	
7/16/2007	< .01		G	
8/30/2007	0.64		G	
9/11/2007	0.073		G	
10/15/2007	no flow		G	
11/15/2007	no flow		G	
12/15/2007	no flow		G	
1/10/2008	0.937		G	
1/28/2008	1.491		G	
2/11/2008	0.765		G	
2/18/2008	0.668		G	
3/3/2008	1.846		G	
3/17/2008	0.626		G	
4/1/2008	0.653		G	
4/15/2008	0.491		G	
5/5/2008	0.433		G	
5/14/2008	0.457		G	
6/1/2008	0.448		G	
7/16/2008	0.434		G	
8/14/2008	0.546		G	
9/9/2008	0.775		G	
10/10/2008	1.335		G	
11/15/2008	0.141		G	
12/9/2008	1.569		G	
1/7/2009	1.783		G	
2/3/2009	2.454		G	
3/4/2009	2.23		G	
4/6/2009	2.455		G	

Sample Date	Total iron (mg/L) pretreatment sampling results	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median
total iron (mg/L)				
5/6/2009	2.331		G	
6/3/2009	2.501		G	
7/29/2009	2.924		G	
8/24/2009	5.151		G	5.15
9/3/2009	3.012		G	3.01
10/28/2009	8.03		G	8.03
11/18/2009	3.927		G	3.93
12/16/2009	3.102		G	3.10
1/28/2010	3.000		G	3.00
2/23/2010	3.300		G	3.30
3/26/2010	3.709		G	3.71
4/21/2010	4.268		G	4.27
5/18/2010	3.119		G	3.12
6/23/2010	5.312		G	5.31
7/21/2010	3.970		G	3.97
8/27/2010	3.230		G	3.23
9/29/2010	3.470		G	3.47
10/29/2010	2.810		G	2.81
11/22/2010	3.190		G	3.19
12/17/2010	3.290		G	3.29
1/24/2011	2.930		G	2.93
2/23/2011	2.410		G	2.41
3/10/2011	2.340		G	
3/10/2011	1.98		D	
3/17/2011	2.180		G	
3/17/2011	2.06		D	
3/24/2011	2.390		G	2.28
3/24/2011	2.28		D	
3/28/2011	2.310		G	
3/30/2011	2.360		G	
3/30/2011	2.04		D	

Sample Date	Total iron (mg/L) pretreatment sampling results	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median
total iron (mg/L)				
4/7/2011	2.390		G	2.43
4/7/2011	2.15		D	
4/14/2011	2.250		G	
4/14/2011	2.11		D	
4/19/2011	2.620		G	
4/19/2011	2.43		D	
4/26/2011	2.550		G	
4/27/2011	6.680		G	
4/27/2011	5.00		D	
5/3/2011	2.050		G	2.10
5/3/2011	2.02		D	
5/12/2011	2.160		G	
5/12/2011	2.00		D	
5/17/2011	2.560		G	
5/17/2011	2.33		D	
5/25/2011	2.07		D	
5/31/2011	2.130		G	
6/27/2011	2.270		G	2.27
7/21/2011	2.660		D	2.53
7/25/2011	2.400		G	
8/22/2011	2.600		G	2.60
9/30/2011	2.790		G	2.79
10/24/2011	1.750		G	2.69
10/25/2011	3.62		D	
11/28/2011	2.470		G	2.47
12/28/2011	3.250		G	3.25
1/12/2012	2.29		G	2.29
2/15/2012	1.58		G	1.58
3/7/2012	3.00		D	2.98
3/23/2012	2.96		G	
4/17/2012	2.45		G	2.45

Sample Date	Total iron (mg/L) pretreatment sampling results	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median
total iron (mg/L)				
5/15/2012	2.73		G	2.82
5/15/2012	2.90		D	
6/12/2012	4.02		G	4.02
7/30/2012	2.99		G	2.99
8/31/2012	2.72		G	2.72
9/30/2012	2.09		G	2.09
10/30/2012		1.77	G	1.77
11/30/2012		1.99	G	1.99
12/20/2012		1.9	G	1.90
1/29/2013		1.92	G	1.92
2/28/2013		1.62	G	1.62
3/28/2013		1.73	G	1.73
4/30/2013		2.11	G	2.11
5/30/2013		1.65	G	1.62
6/19/2013		1.93	D	1.89
6/24/2013		1.85	G	
7/30/2013		1.47	D	1.52
7/30/2013		1.57	G	
8/27/2013		1.44	D	1.49
8/28/2013		1.54	G	
8/29/2013		1.52	G	
9/17/2013		1.48	D	1.51
9/17/2013		1.54	G	
9/26/2013		1.81	G	
10/9/2013		1.71	D	1.59
10/9/2013		1.46	G	
10/17/2013		0.74	G	
10/24/2013		1.35	G	

Sample Date	Total iron (mg/L) pretreatment sampling results	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median
total iron (mg/L)				
11/4/2013		1.19	G	1.31
11/8/2013		1.43	G	
11/14/2013		1.46	G	
11/19/2013		1.49	D	
11/19/2013		1.54	G	
11/26/2013		1.52	G	
12/10/2013		1.65	G	1.60
12/10/2013		1.48	D	
12/12/2013		1.65	G	
12/17/2013		1.51	G	
12/26/2013		1.71	G	
1/14/2014		1.53	G	1.66
1/22/2014		1.72	G	
1/28/2014		1.74	G	
1/28/2014		1.65	D	
2/7/2014		1.91	G	1.78
2/26/2014		1.68	G	
2/26/2014		1.74	D	
3/20/2014		1.29	G	1.37
3/25/2014		1.46	G	
3/25/2014		1.33	D	
3/31/2014		1.38	G	
4/23/2014		1.74	G	1.61
4/30/2014		1.48	G	
5/16/2014		1.38	G	1.39
5/23/2014		1.37	G	
5/28/2014		1.33	D	
5/29/2014		1.49	G	
6/10/2014		1.39	G	1.36
6/10/2014		1.32	D	

Sample Date	Total iron (mg/L) pretreatment sampling results	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median
total iron (mg/L)				
7/1/2014		1.44	G	1.41
7/1/2014		1.38	D	
8/13/2014		1.42	G	1.50
8/19/2014		1.61	G	
8/19/2014		1.46	D	
9/12/2014		1.49	G	1.43
9/15/2014		1.37	D	
9/29/2014		1.44	G	
10/7/2014		1.48	D	1.65
10/9/2014		1.81	G	
10/20/2014		1.66	G	
11/10/2014		2.99	G	2.01
11/24/2014		1.58	G	
11/25/2014		1.46	D	
12/16/2014		1.58	D	1.66
12/16/2014		1.74	G	
1/8/2015		1.59	G	1.52
1/27/2015		1.45	D	
2/17/2015		1.77	G	1.67
2/23/2015		1.55	D	
2/23/2015		1.70	G	
3/9/2015		1.59	G	1.50
3/17/2015		1.40	D	
4/14/2015		1.82	G	1.69
4/30/2015		1.55	D	
5/13/2015		1.63	D	1.63
5/13/2015		1.63	G	
6/17/2015		1.52	G	1.50
6/22/2015		1.47	D	
6/29/2015		1.52	G	

Sample Date	Total iron (mg/L) pretreatment sampling results	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median
total iron (mg/L)				
7/14/2015		1.54	G	1.54
8/6/2015		1.29	D	1.37
8/7/2015		1.44	G	
9/14/2015		1.33	G	1.33
10/1/2015		1.22	G	1.26
10/5/2015		1.33	G	
10/20/2015		1.24	D	
11/9/2015		1.45	G	1.34
11/16/2015		1.22	D	
12/8/2015		1.18	G	1.17
12/8/2015		1.16	D	
1/20/2016		1.11	G	1.10
1/20/2016		1.09	D	
2/4/2016		1.13	G	1.10
2/4/2016		1.07	D	
3/7/2016		1.6	G	1.56
3/7/2016		1.51	D	
4/18/2016		1.01	G	0.99
4/18/2016		0.96	D	
5/10/2016		1.07	G	1.02
5/10/2016		0.96	D	